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The shrub layer spider communities: variation of composition and structure of the gorse clump communities in western France

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The shrub layer spider communities: variation of composition and structure of the gorse clump communities in western France. - The comparison between the spider communities inhabiting the shrub layers of gorses reflects the constancy of a group of dominant species for several years in a same continental study plot. We observe a substitution in the dominant species among the different functionnal groups when comparing the continental, littoral and insular site communities This has to be related to macroclimate differences between the sites investigated. However, the species composition of the functionnal groups of spiders inhabiting different gorse clumps in a same littoral macroclimate area strongly varies The possible reasons for these variations are suggested.

Key-words: spiders - communities - gorse clumps - islands - western France

INTRODUCTION

This study is part of a general work on western France spider communities. Our investigations on this topic started with the description of functional groups in several heathland plant communities with quantitative results on spatial distribution and densities of species according to their hunting habits (Canard 1990). In the present paper, we consider more precisely the structure of spider communities of shrub layers of gorse clumps (*Ulex europaeus* Linné, 1758) which typically belong to littoral and continental heathlands in Brittany. Because of their mosaic distribution, we should find a specific spider community in this type of habitat. Climatic conditions strongly vary between continental and coastal areas (Lariviere & Verdou 1969) therefore the spider communities are compared for three types of gorse clumps - a continental type, a littoral type and an insular type.

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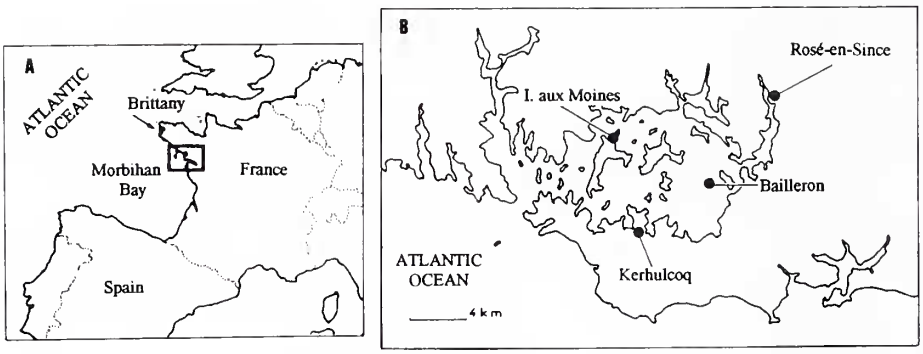
MATERIALS AND METHODS

The continental site lies in central dry heaths of Brittany at 47°58N, 2°53O. The plot was in Baulon and the gorse clumps were investigated during the years 1976-1977, in spring 1980 and in spring 1981 (CANARD 1984). For this site, the spiders were collected once a month by branch beating and branch collecting (CANARD 1984). The littoral and insular gorse clumps were located in the Morbihan Bay in the south of Brittany (about 47°30'N, 3°W) The Morbihan bay forms a great littoral basin scattered with some thirty islands or islets (cf. Map). The bay is characterized by a higher number of sunny days and by a lower number of winter



frosty days than the continental zone because of the inland sea (DENIS 1978). Four sites have been selected in this area; two of them are located on islands (insular sites1, 2): "Ile aux Moines" is one of the biggest island (surface area: 2.74 km^2) and "Ile Bailleron" is one of the smallest (0.05 km^2). These two islands are very close to the continent. The two other sites (littoral site 1: Rosé-en-Since; littoral site 2: Kerhulcoq) are situated along the coast and are fifteen kilometers apart. The gorse clumps investigated in "Ile Bailleron" were less developped (poor vegetation area); However, the three other sites selected in the Morbihan bay exhibit no basic habitat differences (same vegetation height, volume and area). In the Morbihan bay, we only collected the species by branch beating on low and upper gorse layers. The spiders were sampled in june 1995 and the branches were beaten until we collected at least 250 individuals per gorse clump. The comnunities are compared using the Blondel index of communities similarity H'_β (derived from the shannon index) (BLONDEL 1979):

$$H'_\beta = H'_{ab} - 0.5 (H'_a + H'_b)$$

(where, H'_a, H'_b= Shannon index for communities a and b; H'_{ab} = Shannon index for communities mixed). The nomenclature of spiders used follows PLATNICK (1989). Functional groups of species are established according to their hunting habits (CANARD 1990). In order to simplify the comparisons of the spider communities, table 1 and 2 only refer to species represented by at least 5 individuals. The total list of species is given in annex1.

RESULTS

1) Comparison of spider communities inhabiting gorse clumps between the continental zone and the Morbihan Bay

The global comparison between the continental, littoral and insular plots emphasizes the differences between the three spider communities (table 1 and annex 1). The species diversity is similar on continental (43 sp.) and littoral plots (50 sp.) but remains considerably low on the island plots (27 sp.). Among the total of 82 species collected, a low proportion of common species (30%; 25 species) is found on the three sites. Furthermore, the analysis of species distribution according to functional groups (table 1) clearly indicates a substitution concerning the dominant species among these groups. We can observe for instance a complete substitution of the dominant species for ambush hunters and sheet-weavers between the spider communities of continental and littoral or insular gorse clumps. The frame-web spiders communities are nearly the same on the three sites (except *Theridion pallens*), but in this case, there is a substitution in the dominance of the species. The comparison of continental samples shows that, except for *Lathys humilis*, no differences in the dominant spiders species composition are detected between the data collection of march-april 1980 and those of march-april 1981.

2) Comparison of littoral and insular gorse clumps in the Morbihan Bay

60 species were identified in the Morbihan bay (annex 1). No more than 48% of the species are to be found in two different sampling sites at the same time. This low percentage is a result of the great changes in the composition of the dominant species for each functionnal group between littoral and insular gorse clumps (table 2). The two littoral gorse clumps exhibit the higher percentage of common species while the lowest percentage is observed when comparing the communities of insular and littoral gorses (table 3). However, we observed a high percentage of common species between the littoral site 2 and the insular site 1. These results are confirmed when using the Blondel index of similarity which takes into account both presence and dominance of species in the four sites investigated (table 4). The lowest index between insular and littoral communities, and between insular site 1 and littoral site 2 indicates a higher similarity between these communities.

A comparison in the structure of the spider assemblages is given by the relative abundance of the species in the different sites (figure 2). The first littoral site community is clearly dominated by *D. rudis*, which is paradoxally totaly absent on the other sites. *Enoplognatha g. ovata*, one of the dominant species on the littoral site 2, is very poorly collected on islands. The two insular gorse clump communities are dominated by the same group of species but a substitution in the specific dominance can be underlined. These graphs also indicate that one species predominates over the insular communities; therefore the island gorse spider communities are more unbalanced than the littoral gorse spider communities. This result is confirmed by the lowest value of the Shannon evenness index for insular communities (table 5).

TABLE 1

Relative abundance of species (heavy print numbers indicate the main differences in the functionnal groups; bc = branch collecting; bb = branch beating).

	Continental			littoral	insular
	annual sampling	march-april	march-april	june	june
	1976-1977	1980	1981	1995	1995
	(bc)	(bb)	(bb)	(bb)	(bb)
Diurnal wanderers					
Ero aphana			0.2	1.3	
Pardosa nigriceps		0.13	0.4	0.93	
Dendryphantes rudis	4.6	8.2	3.1	**11.8**	
Eris nidicolens				**12.2**	**12.8**
Heliophanus tribulosus					2.1
Ambush-hunters					
Philodromus cespitum	5.7	4	6.9		
Xysticus sp.	**11.4**	0.08	1.4		
Xysticus lanio				5.7	**23.5**
Philodromus glaucinus				1.9	1.9
Frame-web spiders					
Theridion pallens	**6.2**	**9.6**	1.2		
Anelosimus vittatus	2.1	0.53	1		0.35
Dictyna latens	3.6	0.13	0.4	1.3	1.4
Theridion varians	1	0.53		3.2	1.4
Theridion bimaculatum			1.4	0.7	
Anelosimus aulicus	**14**	**25.8**	**19.4**	1.3	
Theridion simile	**27**	**18.2**	**36.9**	1.6	
Theridion mystaceum	**6.8**	**15.6**	**13.9**	3.3	0.5
Lathys humilis	8.3	6.5		2.2	2.8
Theridion tinctum		0.1		2.4	**6.7**
Enoplognatha g. ovata		0.1	1.6	**8.2**	
Lathys sexpustulata				0.8	0.7
Sheet-weavers					
Frontinellina frutetorum	0.5	0.3	1.3		
Peponocranium ludicrum	0.5	1	2.5		
Hybocoptus decollatus				2.1	**10.9**
Linyphia triangularis				2.26	
Lepthyphantes tenuis				3.3	0.52
Oedothorax fuscus				2	
Erigone atra				1	0.17
Orb-weavers					
Araniella curcubitina	1	1.9	0.97		
Zygiella sp.				**9.8**	**26.1**
Araneus diadematus	0.5	0.4	0.19	**10.5**	**1.75**
nocturnal wanderers					
Clubiona comta		0.4	1.17	0.53	
Drassodes cupreus				0.8	
total number of individuals	192	748	512	751	570

Furthermore, specific diversity of the communities strongly decrease on islands. This lowest diversity is closely linked to the low number of sheet-web spiders inhabiting islands (table 6).

TABLE 2

Distribution of species recorded in the Morbihan Bay according to functionnal groups

	Morbihan bay			
	littoral 1	**littoral 2**	**insular 1**	**insular 2**
Diurnal wanderers				
Dendryphantes rudis	**21.1**			
Pardosa nigriceps	1.7			
Ero aphana	1.2	1.5		
Anyphaena accentuata	1.7	0.3	0.4	
Ballus chalybeius	0.7			1.25
Eris nidicolens	6.5	19.4	17	10.4
Heliophanus tribulosus			2	2.2
Ambush-hunters				
Philodromus glaucinus	0.23	3.9	4	0.3
Xysticus lanio	5	6.7	**36**	**13.5**
Frame-web spiders				
Theridion bimaculatum	**0.9**	**0.3**		
Theridion simile	**1.7**	**1.5**		
Anelosimus aulicus	**1.4**	**1.2**		
Lathys sexpustulata	1.4		1.6	
Enoplognatha g. ovata	**3.8**	**14**	0.4	
Theridion mystaceum	2.4	4.6	1.2	
Theridion varians	3.3	3	3.2	
Lathys humilis	3.5	0.6	3.6	2.1
Theridion tinctum	3.8	0.6	2.4	**10.1**
Dyctina latens	1.2	2.4	2.4	
Anelosimus vittatus			**0.4**	**0.3**
Sheet-weavers				
Linyphia triangularis	**4**			
Bathyphantes gracilis	0.47	0.6		
Oedothorax fuscus	3.3	0.3		
Lephtyphantes tenuis	1.6	5.5		0.9
Hybocoptus decollatus	1.9	2.4	6.7	**14.2**
Orb-weavers				
Araneus diadematus	**10.4**	**10.6**	2.4	1.2
Zygiella sp.	7.6	12.8	12.2	**37.2**
Nuctenea umbratica		0.6	0.8	2.2
nocturnal wanderers				
Drassodes cupreus	1.4			
total number of individuals	422	329	253	317

TABLE 3

Percentage of common species between the different plots

	littoral 2	insular 1	insular 2
littoral 1	48%	37.8%	22%
littoral 2	/	44.7%	22.2%
insular 1	/	/	35.5%

TABLE 4

Blondel index of communities similarity

	littoral 2	insular 1	insular 2
littoral 1	0.15	0.19	0.24
littoral 2	/	0.09	0.27
insular 1	/	/	0.11

TABLE 5

Shannon index for the different plots

	littoral		insular	
	1 (Rosé-en-Since)	2 (Kerhulcop)	1 (île aux Moines)	2 (Bailleron)
Shannon diversity index (H')	1.22	1.13	0.92	0.78
Shannon evennness index (J')	0.76	0.74	0.69	0.59

TABLE 6

Number of species according to functionnal group for the different sites (percentages are given in parentheses)

	continental	littoral		insular	
	Baulon	1	2	1	2
Orb-web spiders	7 (16.2)	6 (15.4)	5 (14.7)	4 (19)	7 (33.3)
Frame-webs spiders	13 (30.2)	11 (28.2)	9 (26.4)	8 (38.1)	5 (23.8)
Sheet-webs spiders	6 (14)	10 (25.6)	8 (23.5)	2 (9.5)	2 (9.5)
Ambush hunters	6 (14)	3 (7.7)	4 (11.8)	2 (9.5)	3 (14.3)
Diurnal wanderers	8 (18.6)	7 (18)	4 (11.8)	4 (19)	4 (19)
Nocturnal wanderers	3 (7)	2 (5.1)	4 (11.8)	1 (4.8)	/
total	43	39	34	21	21

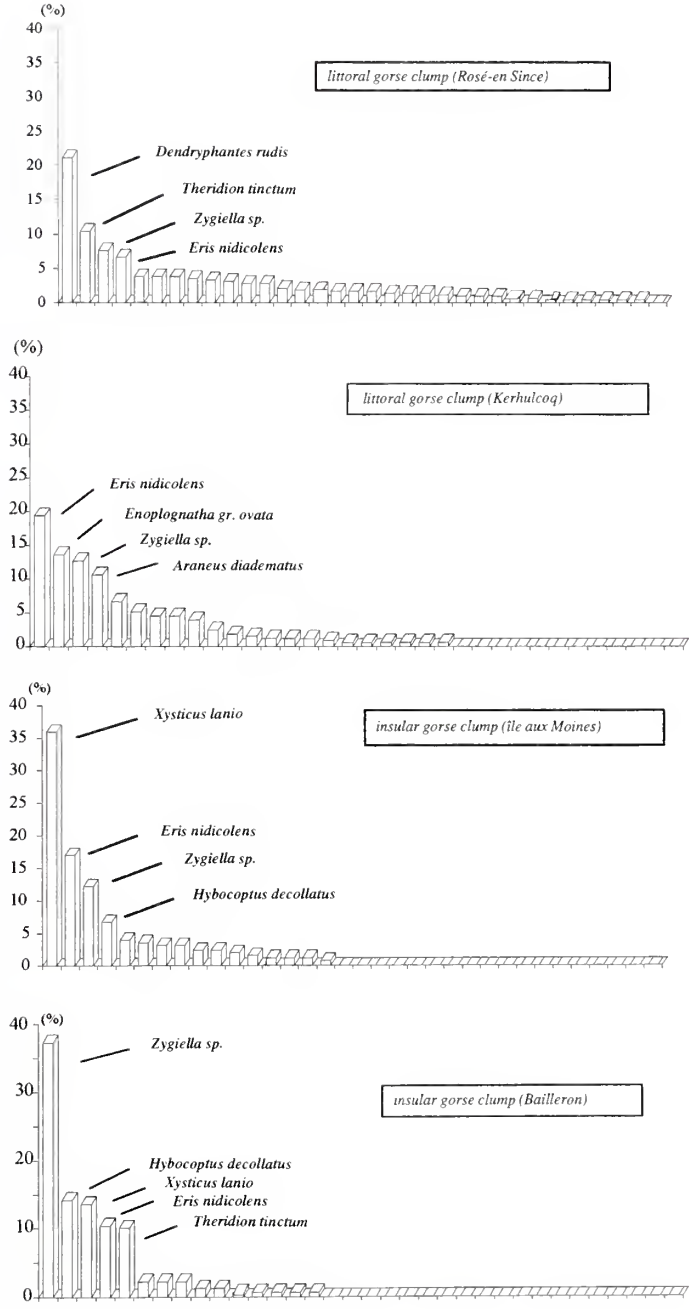


FIG. 2

Relative abundance of the species for the four plots in the Morbihan Bay.

DISCUSSION

This first approach leads to the conclusion that the shrub layer spider communities of gorse clumps vary between continental, littoral and insular sites. Concerning the continental plots, the relative abundance of dominant species can fluctuate from one year to another year, but we can observe a constancy in the presence of these species for 5 years. Numerous other species are also recorded on the gorse clumps but their presence can vary depending on the sampling collection. Most of them are probably typical species inhabiting gorse clumps but they may be underestimated from one sample to the next because of their low density. Among this group, some spiders can also be considered as a guild of "accessory colonizers" and their presence may be dependent on periodically exchange with adjacent zones. There are no considreable variations between the species composition of the "spring community" and the composition of the "annual community" for successive years. This reflects the stability of the spider community of gorse clumps and allows us to compare different communities on the base of the analysis of the spring communities.

Continental and littoral/insular spider communities of gorse clumps strongly differ. These differences are most likely to reflect macroclimate variations between the sites. These climate modifications clearly appear in the species composition of the functional groups. This has to be related to the ecological valence of the species. Evidence of the influence of the warmer macroclimate in the Morbihan Bay is given by the presence of *Eris nidicolens*, *Philodromus glaucinus* and *Lathys sexpustulata* which are typical species of France meridional ecosystems. Concerning the insular plots, the scarcity of suitable and adjacent habitats, the lack of some potential preys and the increase of competition are the well known factors usually evocated to explain the lower species diversity (Mac Arthur & Wilson 1967; Wise 1993). This study shows a decrease in the number of sheet-weaving species inhabiting islands. Because more than 70% of the spider colonist of shrubs may arrived by aerials means (Ehman 1993) and because sheet-weavers are the most frequent ballooning dispersers (Decae 1987), one can expect that insular gorse clumps have to be easily colonized by sheet-weavers. In a previous paper (Canard 1989), we found that the species richness of sheet-weavers in meditteranean zones was low in comparison to temperate zones (where the climate and potential preys are different). The unexpected low number of Linyphiids species on islands could be a result of a difference in macroclimate and/or potential preys between insular and littoral plots. Furthermore, the absence of *D. rudis* and the predominance of the more thermophilous species *E. nidicolens* in the insular diurnal wanderers functionnal group could confirm these suggestions. The comparison between the two littoral spider communities also reveals the absence of the predominant species *D. rudis* on one of the gorse clump. Moreover, a high similarity index is found between this littoral spider community and one of the insular community. This suggests that a difference in microclimate at the shrub layer level occurs between the two littoral zones (this is also suggested because there is no basic differences in the vegetation structure and volume between the two habitats). A previous study demonstrated that the variations in the microclimatic conditions linked

to a variation in the vegetation cover of two similar sites can lead to a change in the species diversity and dominance of ground layer spider communities (CANARD 1990). Although small changes in the spider colonization can occur in relation with the specific structure of each gorse clump, these results obviously suggests that shrub layers spiders communities seems also dependent on microclimatic conditions. Furthermore unpublished observations induce us to suggest that the species composition and the species dominance of continental spider communities of gorse clumps are less exposed to fluctuations than littoral ones because of the most uniformous macroclimate of continental areas. Further studies on other sites are now needed to confirm these hypothesis.

ANNEX 1

Total list of species with numbers of individuals collected in all the sites.

	Continental (43 sp.) annual sampling 1976 -1977	Continental (43 sp.) march-april 1980	Continental (43 sp.) march-april 1981	littoral (50 sp.) june 1995	insular (27 sp.) june 1995
total number	*192*	*748*	*512*	*751*	*570*
Dominant species					
Philodromus cespitum	11	30	35		
Theridion pallens	12	72	6		
Xysticus sp.	22	6	7		
Anelosimus aulicus	27	193	99	10	
Theridion mystaceum	13	117	71	25	3
Lathys humilis	16	49		17	16
Dendryphantes rudis	9	62	16	89	
Encoplognatha ovata		1	8	62	
Theridion simile	52	136	189	12	
Araneus diadematus	1	3	1	79	10
Eris nidicolens				92	73
Hybocoptus decollatus				16	62
Theridion tinctum		1		18	38
Xysticus lanio				43	134
Zygiella sp.				74	149
others species					
Anelosimus vittatus	4	4	5		2
Araneus angulatus	1				2
Ballus chalybeius		1		3	4
Cheiracanthium sp.			1	1	
Clubiona comta		3	6	4	
Dictyna latens	7	1	2	10	8
Ero aphana			1	10	
Heliophanus cupreus	1	3	2	3	
Mangora acalypha		2	1	2	
Pardosa nigriceps		1	2	7	
Salticus scenicus		1			1
Theridion bimaculatum			7	5	
Theridion varians	2	4		24	8
Anyphaena accentuata				8	
Araniella cucurbitina	2	14	5		
Ceratinella brevipes			2		
Clubiona sp.		4	3		
Crustulina sp.			1		
Drassodes sp.	3	1	2		
Dictyna arundinacea	1	10	1		
Frontinellina frutetorum	1	2	7		
Halnia sp.	1				
Meta sp.		1			
Misumena vatia		2			
Neoscona adianta			3		
Peponocranium ludicrum	1	8	13		
Philodromus rufus		4	3		
Phlegra fasciata	1				

Pisaura mirabilis		1			
Tetragnatha sp.	1	2			
Theridion blackwalli		3	4		
Tiso vagans		1			
Xysticus tortuosus	2				
Linyphiides indeter.	1	4	10		
Agyneta subtilis				2	
Bathyphantes gracilis				4	
Clubiona neglecta				2	
Drassodes cupreus				6	
Dysdera crocota				3	
Erigone vagans				2	
Euophrys erratica				2	
Gibbaranea gibbosa				1	
Gongylidiellum vivum				1	
Hypomma bituberculatum				1	
Linyphia triangularis				17	
Milleriana inerrans				1	
Nigma puella				1	
Meta mengei				1	
Oedothorax fuscus				15	
Ozyptila praticola				1	
Ozyptila simplex				1	
Pachygnatha clercki				1	
Pocadicnemis pumila				1	
Tetragnatha montana				1	
Tibellus sp.				1	
Erigone atra				8	1
Lathys sexpustulata				6	4
Leptyphantes tenuis				25	3
Nuctenea umbratica				2	9
Pirodromus glaucinus				14	11
Philodromus dispar				1	2
indetermined (immatures)				16	3
Achaearanea simulans					1
Dipoena melanogaster					2
Episinus sp.					1
Tetragnatha pinicola					1
Heliophanus tribulosus					12
Zilla diodia					1
Hyptiotes sp.					2

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